PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-046215

(43)Date of publication of application : 14.02.2003

(51)Int.Cl. H05K 1/18
H01L 23/12
H05K 3/40

(21)Application number : 2001-228420

(22)Date of filing : 27.07.2001

(71)Applicant : KYOCERA CORP

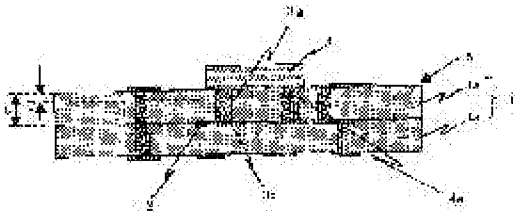
(72)Inventor : SERI TAKUJI
HAYASHI KATSURA

(54) WIRING BOARD WITH ELECTRONIC ELEMENT AND ITS MANUFACTURING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To solve the problem that, when the size of a wiring board with electronic element is reduced and the packaging density of the board is increased, the thermal shock resistance and connection reliability of the board have not been improved.

SOLUTION: The wiring board 5 with electronic element is provided with an insulating layer 1a, wiring conductors 2 arranged on the layer 1a, and through conductors 3b electrically connected to the conductors 2 and the electrodes 4a of an electronic element 4. The board 5 is also provided with the electronic element 4 the electrodes 4a of which are electrically connected to the through conductors 3b. The electrodes 4a of the element 4 are formed in projecting states and, at the same time, the front end sections of the electrodes 4a are embedded in the conductors 3b. Since the electrodes 4a of the element 4 are firmly connected to the conductors 3b by anchoring effects, no by peeling disconnection caused occurs between the element 4 and wiring conductors 2 even when the wiring board 5 is subjected to thermal shock tests and reflow soldering. Consequently, the thermal shock resistance and connection reliability of the wiring board 5 are improved.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] wiring arranged in the insulating layer and this insulating layer -- a conductor and this wiring -- the penetration electrically connected to the electrode of an electronic device while connecting with a conductor electrically -- with a conductor it carries on said insulating layer -- having -- the electrode -- said penetration -- while it is the wiring substrate with an electronic device which comes to provide the electronic device electrically connected with the conductor and the electrode of said electronic device is a letter of a projection -- the point -- said penetration -- the wiring substrate with an electronic device characterized by being embedded at the conductor.
[Claim 2] said penetration -- the wiring substrate with an electronic device according to claim 1 characterized by a conductor consisting of a conductive paste.
[Claim 3] wiring electrically connected with this conductive paste while form a through tube in an insulating layer and filling up this through tube with a conductive paste -- the manufacture approach of the wiring substrate with an electronic device characterized by to provide the process which forms a conductor, the process which embeds the point of said electrode at said conductive paste while carrying the electronic device which has the electrode of the letter of a projection on said insulating layer, and the process which stiffen said conductive paste after an appropriate time.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the wiring substrate with an electronic device which carries an electronic device especially in some wiring substrates, and grows into it about the wiring substrate used for electronic equipment, such as various AV equipments, a household-electric-appliances device, communication equipment and a computer, and its peripheral device.
[0002]
[Description of the Prior Art] wiring of plurality [front face / which consist of organic resin ingredients, such as an insulating layer or a glass epoxy resin with which the wiring substrate with an electronic device consists of ceramic ingredients, such as an alumina, conventionally, / of an insulating layer / the interior and the front face] -- while forming a conductor and carrying out loading attachment of the electronic devices, such as a semiconductor device, and a capacitor, a resistance element, on this front face -- these electrodes -- each wiring -- it is formed by connecting with a conductor.
[0003] However, small and thin shape, and lightweight-ization is required as electronic equipment being represented by mobile communication equipment, and small and densification are increasingly required also for the wiring substrate with an electronic device carried in such electronic equipment in recent years. For this reason, it is necessary to adopt a small thing and for the electronic device carried in a wiring substrate with an electronic device to also make a component-side product small as much as possible.
[0004] Moreover, recently, mounting an electronic device in the interior of a wiring substrate is also proposed in order to reduce the number of the electronic devices mounted in the front face of a wiring substrate with an electronic device and to miniaturize a wiring substrate with an electronic device.
[0005]
[Problem(s) to be Solved by the Invention] however, small and densification require increasingly in recent years -- having -- coming -- wiring of a wiring substrate with an electronic device, while a conductor makes it detailed The electronic device mounted in a wiring substrate front face with an electronic device or the interior is also miniaturized. When the area of a connection with a conductor becomes small and the spalling test which is a cycle trial of an elevated temperature and low temperature is performed, big stress occurs to both according to the difference of the coefficient of thermal expansion of the electrode of an electronic device, and an insulating layer. an electronic device and wiring -- an electronic device and wiring -- a conductor -- it had the trouble of exfoliating and disconnecting in between.
[0006] moreover, the elevated-temperature reflow process at the time of carrying an electronic device on a wiring substrate -- setting -- the difference of the thermal expansion of an insulating layer, and the thermal expansion of an electronic device -- a location gap of an electronic device -- generating -- consequently, the electrode of an electronic device and wiring -- it also had the trouble that connection of a conductor could not be performed normally.
[0007] This invention is thought out in view of the trouble of this conventional technique, and the

purpose is in offering the small and lightweight wiring substrate with an electronic device excellent in thermal shock resistance and connection dependability.
[0008]
[Means for Solving the Problem] wiring with which the wiring substrate with an electronic device of this invention was arranged in an insulating layer and this insulating layer -- with a conductor this wiring -- the penetration electrically connected to the electrode of an electronic device while connecting with a conductor electrically -- with a conductor it carries on an insulating layer -- having -- the electrode -- penetration -- while it is the wiring substrate with an electronic device which comes to provide the electronic device electrically connected with the conductor and the electrode of an electronic device is a letter of a projection -- the point -- penetration -- it is characterized by being embedded at the conductor.
[0009] moreover, the wiring substrate with an electronic device of this invention -- penetration -- it is characterized by a conductor consisting of a conductive paste.
[0010] Furthermore, the manufacture approach of the wiring substrate with an electronic device of this invention While forming a through tube in an insulating layer and filling up this through tube with a conductive paste wiring electrically connected with this conductive paste, while carrying the process which forms a conductor, and the electronic device which has the electrode of the letter of a projection on an insulating layer It is characterized by providing the process which embeds the point of an electrode at a conductive paste, and the process which stiffens a conductive paste after an appropriate time.
[0011] while making the electrode of an electronic device into the letter of a projection according to the wiring substrate with an electronic device of this invention -- the point -- penetration -- the electrode of an electronic device since it is embedded at the conductor -- penetration -- the case where connected with the conductor firmly according to the anchor effect, and the spalling test which is a cycle trial of an elevated temperature and low temperature is performed -- also setting -- an electronic device and wiring -- a conductor -- it does not exfoliate and disconnect in between moreover -- ****** a difference arises in the thermal expansion of an electronic device and an insulating layer in the case of an elevated-temperature reflow at the time of mounting an electronic device -- the letter electrode of a projection -- penetration -- since it is embedded at the conductor -- a location gap -- it can control -- consequently, the electrode of an electronic device and wiring -- connection of a conductor can consider as the wiring substrate with an electronic device excellent in good connection dependability.
[0012] moreover -- according to the wiring substrate with an electronic device of this invention -- the above-mentioned configuration -- setting -- penetration -- the point of the electrode of the letter of a projection of an electronic device since a conductor shall be consisted of a conductive paste -- penetration -- the time of embedding at a conductor -- a conductive paste -- the electrode whole -- a wrap -- things are made, consequently both connection area can become large, connection can be strengthened, and it can carry out as a wiring substrate with an electronic device with high connection dependability.
[0013] Furthermore, while according to the manufacture approach of the wiring substrate with an electronic device of this invention forming a through tube in an insulating layer and filling up this through tube with a conductive paste wiring electrically connected with this conductive paste, while carrying the process which forms a conductor, and the electronic device which has the electrode of the letter of a projection on an insulating layer From providing the process which embeds the point of an electrode at a conductive paste, and the process which stiffens a conductive paste after an appropriate time It can fix [consequently] firmly to a conductor. the electrode of the letter of a projection of an electronic device -- penetration -- the time of embedding at a conductor -- penetration -- stiffening a conductive paste, while being able to embed easily, since a conductor is in the condition of not hardening -- the electrode of an electronic device -- penetration -- the case where a spalling test is performed -- also setting -- an electronic device and wiring -- a conductor -- the wiring substrate with an electronic device which is not exfoliated and disconnected in between can be manufactured easily.
[0014]
[Embodiment of the Invention] Next, the wiring substrate with an electronic device of this invention is

explained to a detail based on an attached drawing.
[0015] Drawing 1 is the sectional view showing an example of the operation gestalt of the wiring substrate with an electronic device of this invention, and drawing 2 is the sectional view showing an example of the operation gestalt at the time of carrying an electronic device in the interior of a wiring substrate in the wiring substrate with an electronic device of this invention. the insulating substrate to which 1a changes from insulating-layer 1a of plurality [1 / an insulating layer and] in these drawings, and 2 -- wiring -- a conductor and 3a -- a through tube and 3b -- penetration -- a conductor and 4 are electronic devices, such as a capacitor, and the wiring substrate 5 with an electronic device of this invention mainly consists of these. In addition, the example which carried out the laminating of the two-layer insulating-layer 1a to drawing 1 , carried out the laminating of the insulating-layer of five layers 1a to drawing 2 , and manufactured the wiring substrate 5 with an electronic device is shown. Moreover, in the example of drawing 2 , the through hole 6 which contains an electronic device 4 is formed in a part of insulating-layer 1a (this example bilayer), and the electronic device 4 is laid under this through hole 6. furthermore -- an insulating-layer 1a front face -- wiring -- a conductor 2 arranges -- having -- penetration -- a conductor -- it has connected with electrode 4a of an electronic device 4 electrically through 3b. moreover -- the wiring substrate 5 with an electronic device of this invention -- electrode 4a of an electronic device 4 -- the letter of a projection -- it is -- penetration -- a conductor -- it is embedded at 3b.
[0016] insulating-layer 1a -- wiring -- it is desirable to have a function as a conductor 2 or a base material of an electronic device 4, to consist of organic resin ingredients, such as ceramic ingredients, such as an alumina and crystallized glass, or an epoxy resin, and bismaleimide triazine resin, thermosetting polyphenylene ether resin, liquid crystal polymer resin, and to consist of organic resin ingredients, such as thermosetting polyphenylene ether resin from a viewpoint of lightweight-izing, detailed-izing, a RF property, and workability and liquid crystal polymer resin, especially.
[0017] In addition, when insulating-layer 1a consists of an organic resin ingredient Coupling agents, such as a silane system for raising a mechanical strength, and a titanate system, Light stabilizer, such as an ultraviolet ray absorbent for improving the antioxidant and lightfastness for improving thermal stability, Fire-resistant assistants, such as a fire-resistant agent of the halogen system for improving fire retardancy, or a phosphoric-acid system, an antimony system compound, and boric-acid zinc, metaboric acid barium, a zirconium dioxide, Lubricant, such as a higher fatty acid for improving lubricity, and higher-fatty-acid ester, a higher-fatty-acid metal salt, a fluorocarbon system surfactant, In order to adjust a coefficient of thermal expansion And/or, a mechanical strength Aluminum oxide, oxidization silicon, titanium oxide, barium-oxide, strontium-oxide and zirconium dioxide and calcium oxide, zeolite, silicon nitride, alumimium nitride, silicon carbide, and potassium titanate barium titanate - for making it improve Fillers, such as strontium titanate titanic-acid calcium boric-acid aluminum stannic-acid barium zirconic acid barium zirconic acid strontium, or the glass fabrics which wove fibrous glass into blanket-like may be made to contain.
[0018] Such insulating-layer 1a to for example, inorganic insulation powder, such as the aluminum oxide, the silicon nitride, the alumimium nitride, the silicon carbide, titanium oxide, barium oxide, a strontium oxide, a zirconium dioxide, a calcium oxide, etc. whose particle size is about 0.1-15 micrometers Thermoplastics, such as thermosetting resin, such as an epoxy resin, phenol resin, polyimide resin, a bismaleimide resin, and thermosetting polyphenylene ether resin, or liquid crystal polyester polyphenylene ether resin, a solvent, a plasticizer, a dispersant, etc. are added. By adopting the sheet casting methods, such as the well-known doctor blade method, conventionally, and making the obtained paste with the shape of a sheet Or by being immersed, pulling up perpendicularly the glass-fabrics glass which wove fibrous glass into blanket-like during the above-mentioned paste, and drying, insulating-layer 1a and the precursor sheet which changes are formed, and it is obtained by cutting in desired magnitude after an appropriate time.
[0019] In addition, as the electronic device 4 carried shows drawing 2 with a sectional view, when being formed in the interior of an insulating substrate 1, the through hole 6 for holding an electronic device 4 in a part of insulating-layer 1a is drilled. Such a through hole 6 is formed in insulating-layer 1a

according to the magnitude and the configuration of an electronic device 4 by performing drilling processing by the well-known laser process, and punching processing by the punching method conventionally.
[0020] moreover -- insulating-layer 1a -- at least one field of a vertical side -- wiring -- covering formation of the conductor 2 is carried out. wiring -- the thickness consists of conductive pastes [, such as the metallic foil or copper of right conductivity and silver, tungsten molybdenum], such as copper and gold, by about 2-30 micrometers, and a conductor 2 has the function to connect electrically to an external electrical circuit (not shown) the electronic device 4 carried in the wiring substrate 5 with an electronic device.
[0021] such wiring -- a conductor 2 is formed carrying out covering formation of the metallic foil which carried out pattern formation to the precursor sheet used as insulating-layer 1a with the subtractive process using a well-known photoresist, for example, changes from copper to it with a replica method etc., or by printing conventionally the conductive paste which added thermosetting resin or thermoplastics, a solvent, a plasticizer, a dispersant, etc., and obtained metal powder, such as copper, and silver, tungsten molybdenum, using well-known screen printing.
[0022] furthermore, the penetration whose diameter is about 20-150 micrometers at insulating-layer 1a -- a conductor -- 3b is formed. penetration -- a conductor -- wiring with which 3b is located up and down on both sides of insulating-layer 1a -- a conductor -- two comrades and wiring -- it has the function to connect electrically a conductor 2 and electrode 4a of an electronic device 4. such penetration -- a conductor -- 3a is formed by embedding conventionally the conductive paste which changes from copper, silver, gold, solder, etc. to this through tube 3a with well-known screen printing, after forming through tube 3a by performing drilling processing to insulating-layer 1a with laser.
[0023] and this penetration -- a conductor -- while connecting electrically, each electrode 4a of the electronic device 4 carried getting down to a part of 3b and electrode 4a of an electronic device 4 being a letter of a projection in the wiring substrate 5 with an electronic device of this invention -- that point -- penetration -- a conductor -- it is embedded at 3b. Moreover, this is important.
[0024] while making electrode 4a of an electronic device 4 into the letter of a projection according to the wiring substrate 5 with an electronic device of this invention -- the point -- penetration -- a conductor -- electrode 4a of the electronic device 4 since it is embedded at 3b -- penetration -- a conductor -- the case where connected with 3b firmly according to the anchor effect, and the spalling test which is a cycle trial of an elevated temperature and low temperature is performed -- an electronic device 4 and wiring -- it does not exfoliate and disconnect between conductors 2 moreover -- ****** a difference arises in the thermal expansion of an electronic device 4 and insulating-layer 1a in the case of an elevated-temperature reflow at the time of mounting an electronic device 4 -- electrode 4a of the letter of a projection -- penetration -- a conductor -- since it connects with 3b firmly according to an anchor effect -- a location gap of an electronic device 4 -- it can control -- consequently, electrode 4a of an electronic device 4 and wiring -- connection of a conductor 2 can consider as the wiring substrate 5 with an electronic device excellent in good connection dependability.
[0025] Such electrode 4a of the letter of a projection of an electronic device 4 is formed by adopting well-known screen printing and carrying out copy printing of the conductive pastes, such as copper, and silver, tungsten molybdenum, to the front face of an electronic device 4 conventionally.
[0026] In addition, although a round shape, an ellipse form, or a polygon is sufficient as the cross section of a direction parallel to insulating-layer 1a, as for the projection configuration of electrode 4a of an electronic device 4, from a viewpoint of easing the stress of a connection, it is desirable that they are a round shape and an ellipse form. moreover, the cross section of electrode 4a of a direction parallel to insulating-layer 1a -- electrode 4a of the letter of a projection -- penetration -- a conductor -- from a viewpoint of preventing a bite lump of air in case it embeds at 3b, it is more desirable than a connection with an electronic device 4 that the direction of a point is small. Furthermore, height T of electrode 4a has the desirable range of 0.1t-0.5t, when thickness of insulating-layer 1a is set to t. Sufficient anchor effect is not acquired with height T of electrode 4a being less than 0.1t. Consequently, if there is an inclination which a connection disconnects in a spalling test and it exceeds 0.5t, when pressurizing and

heating the wiring substrate 5 with an electronic device finally and multilayering, A conductive paste disturbs greatly from through tube 3a, and there is a danger of generating poor adhesion of insulating-layer 1a. Therefore, as for height T of electrode 4a, it is desirable that they are 0.1t-0.5t to thickness t of an insulating layer 1.

[0027] Moreover, what is necessary is for the path of the cross section of a direction parallel to insulating-layer 1of electrode 4a of letter of projection a to be a little smaller than the diameter of a through hole 6, and just to decide it with the location precision searched for. furthermore, an electronic device 4 and penetration -- a conductor -- connection of 3b -- the penetration whose electrode 4a of the letter of a projection of an electronic device 4 is not hardened -- a conductor -- the inside of 3b -- putting -- ****** and after an appropriate time -- heating -- penetration -- a conductor -- such a wiring substrate 5 with an electronic device performed by hardening 3b is manufactured by the following approach. First, through tube 3a is formed in the location of a request of insulating-layer 1a and the precursor sheet which changes by laser drilling processing etc. the conductive paste which changes from copper etc. to this through tube 3a -- for example, screen printing -- using -- being filled up -- penetration -- a conductor, after forming 3b Pattern formation was carried out. Temperature a copper metallic foil 100-200 degrees C, a pressure -- the conditions of 0.5-10MPa -- 10 minutes - a 1-hour hotpress -- carrying out -- insulating-layer 1a -- imprinting -- wiring -- a conductor 2 and penetration -- a conductor -- 3b -- electric -- connecting -- wiring -- a conductor 2 and penetration -- a conductor -- 1st insulating-layer 1a in which 3b was formed is obtained. in addition, this time -- penetration -- a conductor -- as for 3b, what is considered as the condition which has not been hardened completely of not hardening is desirable. Next, apart from the above-mentioned insulating-layer 1a, through tube 3a is formed in the location of a request of insulating-layer 1a and the precursor sheet which changes by laser drilling processing etc. the conductive paste which changes from copper etc. to this through tube 3a -- for example, screen printing -- using -- being filled up -- penetration -- a conductor -- the electronic device 4 after forming 3b -- electrode 4a of that letter of a projection -- penetration -- a conductor -- it carries so that it may be embedded at 3b, and 2nd insulating-layer 1a which has an electronic device 4 is obtained. and the 1st and insulating-layer 1of ** 2nd a -- wiring of 1st insulating-layer 1a -- penetration of insulating-layer 1a of a conductor 2 and the 2nd ** -- a conductor -- a laminating is carried out so that 3b may lap, and it is manufactured after an appropriate time by temperature's carrying out at 150-300 degrees C, and a pressure's carrying out a hotpress on condition that 0.5-10MPa for 30 minute - 24 hours, and carrying out full hardening of a precursor sheet and the conductive paste.

[0028] In addition, what is necessary is to carry out the laminating of the 1st insulating-layer 1a in which the larger through hole 6 a little than an electronic device 4 was formed to the field corresponding to the top face of 2nd insulating-layer 1a to an electronic device 4, and just to carry out a hotpress on the same conditions as the above after an appropriate time, when forming an electronic device 4 in the interior of a wiring substrate. moreover, the 2nd insulating layer 1 which carried the electronic device 4 -- wiring -- a conductor 2 may be formed. in this case, penetration -- a conductor -- changing 3b into the condition which has not been hardened completely of not hardening -- electrode 4a of the letter of a projection of an electronic device 4 -- penetration -- a conductor -- it can embed easily at 3b.

[0029] while making electrode 4a of an electronic device 4 into the letter of a projection in this way according to the wiring substrate 5 with an electronic device of this invention -- the point -- penetration -- a conductor -- electrode 4a of the electronic device 4 since it is embedded at 3b -- penetration -- a conductor -- the case where connected with 3b firmly according to the anchor effect, and the spalling test which is a cycle trial of an elevated temperature and low temperature is performed -- also setting -- an electronic device 4 and wiring -- it does not exfoliate and disconnect between conductors 2 moreover -- ****** a difference arises in the thermal expansion of an electronic device 4 and insulating-layer 1a in the case of an elevated-temperature reflow at the time of mounting an electronic device 4 -- letter electrode of projection 4a -- penetration -- a conductor -- a location gap since it is embedded at 3b -- it can control -- consequently, electrode 4a of an electronic device 4 and wiring -- connection of a conductor 2 can consider as the wiring substrate 5 with an electronic device excellent in good connection dependability.

[0030] Next, the manufacture approach of the wiring substrate with an electronic device of this invention is explained to a detail based on drawing 3 . Drawing 3 is a sectional view for every process for manufacturing the wiring substrate with an electronic device of drawing 2 .
[0031] First, as shown to drawing 3 (a) in a sectional view, the precursor sheet which is not hardened [insulating-layer 11a and / which change] is prepared, and through tube 13a whose diameter is about 20-150 micrometers is drilled in a desired part by laser beam machining at this precursor sheet.
[0032] The precursor sheet which is not hardened [such insulating-layer 11a and / which change] It consists of organic resin ingredients, such as ceramic ingredients, such as an alumina and crystallized glass, or an epoxy resin, and bismaleimide triazine resin, thermosetting polyphenylene ether resin, liquid crystal polymer resin. When insulating-layer 11a consists of an organic resin ingredient Coupling agents, such as a silane system for raising a mechanical strength, and a titanate system, Light stabilizer, such as an ultraviolet ray absorbent for improving the antioxidant and lightfastness for improving thermal stability, Fire-resistant assistants, such as a fire-resistant agent of the halogen system for improving fire retardancy, or a phosphoric-acid system, an antimony system compound, and boric-acid zinc, metaboric acid barium, a zirconium dioxide, Lubricant, such as a higher fatty acid for improving lubricity, and higher-fatty-acid ester, a higher-fatty-acid metal salt, a fluorocarbon system surfactant, In order to adjust a coefficient of thermal expansion And/or, a mechanical strength Aluminum oxide, oxidization silicon, titanium oxide, barium-oxide, strontium-oxide and zirconium dioxide and calcium oxide, zeolite, silicon nitride, alumimium nitride, silicon carbide, and potassium titanate barium titanate - for making it improve Fillers, such as strontium titanate titanic-acid calcium boric-acid aluminum stannic-acid barium zirconic acid barium zirconic acid strontium, or the glass fabrics which wove fibrous glass into blanket-like may be made to contain.
[0033] Such a precursor sheet is manufactured by the following approaches, when using the composite material of thermosetting resin and inorganic insulation powder as an insulating material. First, the mixture which was adding thermosetting resin to the inorganic insulation powder mentioned above with the solvent so that the amount of inorganic insulation powder might become with 20 - 80 volume % is obtained, this mixture is mixed with the means of a kneading machine (kneader), 3 rolls, etc., and a paste is manufactured. And after adopting sheet forming methods, such as the rolling-out method, and an extrusion process, a radiation method, a doctor blade method, and fabricating this paste in the shape of a sheet, when thermosetting resin heats and dries to the temperature which does not carry out full hardening, the precursor sheet used as insulating-layer 11a manufactures. In addition, a paste is a fluid which has suitably the predetermined viscosity which comes to add solvents, such as toluene, butyl acetate, a methyl ethyl ketone, a methanol, methyl-cellosolve acetate, isopropyl alcohol, methyl isobutyl ketone, and dimethylformamide, to the composite material of thermosetting resin and inorganic insulation powder, and although the viscosity is based also on a sheet forming method, 100-3000poise is desirable [viscosity].
[0034] next, the conductive paste which consists of copper, silver, gold, solder, etc. in through tube 13a as shown to drawing 3 (b) in a sectional view -- the former -- well-known screen printing etc. -- adopting -- being filled up -- penetration -- a conductor -- 13b is formed.
[0035] next, wiring put on the front face and rear face of a precursor sheet as shown to drawing 3 (c) in a sectional view -- a conductor 12 is prepared. and a sectional view shows to drawing 3 (d) -- as -- wiring -- a conductor 12 -- wiring required for the front face and rear face of a precursor sheet -- a conductor 12 and penetration -- a conductor -- it piles up and imprints so that 13a may connect electrically.
[0036] in addition -- this example -- wiring -- formation of a conductor 12 -- a replica method -- carrying out -- **** -- such wiring -- a conductor 12 is formed by the approach described below. first, etching after forming a resist layer so that it may be manufactured by the front face of the base materials 20, such as a mold release sheet, with plating etc., an electrolysis metallic foil with a thickness of 1-35 micrometers it is thin from one sort or two sorts or more of alloys chosen from copper, gold, silver, aluminum, etc. may be pasted up and it may become the mirror image pattern of a desired circuit pattern on the front face and resist removal -- wiring of the mirror image of a predetermined circuit pattern -- a conductor 12 is formed. next, wiring -- covering to the front face and rear face of a precursor sheet of a

conductor 12 -- wiring -- after a pressure carries out pressurization heating of the base material 20 with which the conductor 12 was formed superposition and after an appropriate time to the front face and rear face of a precursor sheet on the conditions 0.5 - 10MPa and whose temperature are 60-150 degrees C, by removing a base material 20 shows to a sectional view at drawing 3 (e) -- as -- wiring -- a conductor 12 is put on a precursor sheet. in addition, this time -- penetration -- a conductor -- what is considered as the condition which has not been hardened completely of not hardening is important for 13b.

[0037] Moreover, as a base material 20, well-known things, such as polyethylene terephthalate, polyethylenenaphthalate, polyimide, polyphenylene sulfide, a vinyl chloride, and polypropylene, can be used. 10-100 micrometers is suitable for the thickness of a base material, and its 25-50 micrometers are desirably good. wiring formed by a base material bending [deformation or] as the thickness of a base material is less than 10 micrometers -- a conductor 12 -- disconnecting -- being easy -- if thickness exceeds 100 micrometers, the flexibility of a base material will be lost, and there is an inclination for exfoliation of the base material 20 from a precursor sheet to become difficult. Moreover, in order to form an electrolysis metallic foil in base material 20 front face, well-known adhesives, such as acrylic, and a rubber system, a silicon system, an epoxy system, may be used.

[0038] And two or more precursor sheets manufactured through the process of above-mentioned (a) - (f) as shown to drawing 3 (f) in a sectional view, The laminating of the precursor sheet is carried out. the penetration which prepares the electronic device 14 which has electrode 14a of the letter of a projection, next consists the point of electrode 14a of a conductive paste -- a conductor, while embedding at 13b The wiring substrate 15 with an electronic device of this invention shown in drawing 3 (g) with a sectional view is completed by temperature's carrying out at 150-300 degrees C, and a pressure's carrying out a hotpress on condition that 0.5-10MPa for 30 minute - 24 hours, and carrying out full hardening of a precursor sheet and the conductive paste.

[0039] In addition, what is necessary is just to drill the through hole 16 which holds an electronic device 14 by laser or the punching method in the part in which the electronic device 14 of a precursor sheet is held, before carrying out the laminating of the precursor sheet although drawing 3 shows the example in which the electronic device 14 was formed to the interior of a wiring substrate.

[0040] As explained above, according to the manufacture approach of the wiring substrate 15 with an electronic device of this invention electrode 14a of the letter of a projection of an electronic device 14 -- penetration -- a conductor, in case it embeds at the conductive paste which forms 13b It can fix firmly to 13b. the penetration which consists electrode 14a of an electronic device 14 of a conductive paste by stiffening a conductive paste while being able to embed easily, since a conductive paste is in the condition of not hardening -- a conductor -- consequently, the case where a spalling test is performed -- also setting -- an electronic device 14 and wiring -- the wiring substrate 15 with an electronic device which is not exfoliated and disconnected between conductors 12 can be manufactured easily.

[0041] In addition, electrode 14a of the letter of a projection of an electronic device 14 is formed by adopting well-known screen printing and carrying out copy printing of the conductive pastes, such as copper, and silver, tungsten molybdenum, to the front face of an electronic device 14 conventionally. Furthermore, although a round shape, an ellipse form, or a polygon is sufficient as the cross section of a direction parallel to insulating-layer 11a, as for the projection configuration of electrode 14a of an electronic device 14, from a viewpoint of easing the stress of a connection, it is desirable that they are a round shape and an ellipse form. moreover, the cross section of electrode 14a of a direction parallel to insulating-layer 11a -- electrode 14a of the letter of a projection -- penetration -- a conductor -- from a viewpoint of preventing a bite lump of air in case it embeds at 13b, it is more desirable than a connection with an electronic device 14 that the direction of a point is small. Furthermore, height T of electrode 14a has the desirable range of 0.1t-0.5t, when thickness of insulating-layer 11a is set to t. Sufficient anchor effect is not acquired with height T of electrode 14a being less than 0.1t. Consequently, if there is an inclination which a connection disconnects in a spalling test and it exceeds 0.5t, when pressurizing and heating the wiring substrate 15 with an electronic device finally and multilayering, A conductive paste disturbs greatly from through tube 13a, and there is a danger of generating poor adhesion of insulating-layer 11a. Therefore, as for height T of electrode 14a, it is

desirable that they are 0.1t-0.5t to thickness t of insulating-layer 11a. Moreover, what is necessary is for the path of the cross section of a direction parallel to insulating-layer 11of electrode 14a of letter of projection a to be a little smaller than the diameter of a through hole 16, and just to decide it with the location precision searched for.

[0042] according to the manufacture approach of the wiring substrate with an electronic device of this invention in this way -- the electrode of an electronic device, and wiring -- connection of a conductor can offer the wiring substrate with an electronic device excellent in good connection dependability.

[0043] In addition, although the above-mentioned example showed the example in case the number of the electronic devices carried in a wiring substrate with an electronic device is one, it is satisfactory to form two or more electronic devices in the front face and the interior of a wiring substrate at all.

[0044]

[Effect of the Invention] while making the electrode of an electronic device into the letter of a projection according to the wiring substrate with an electronic device of this invention -- the point -- penetration -- the electrode of an electronic device since it is embedded at the conductor -- penetration -- the case where connected with the conductor firmly according to the anchor effect, and the spalling test which is a cycle trial of an elevated temperature and low temperature is performed -- also setting -- an electronic device and wiring -- a conductor -- it does not exfoliate and disconnect in between moreover -- ****** a difference arises in the thermal expansion of an electronic device and an insulating layer in the case of an elevated-temperature reflow at the time of mounting an electronic device -- the letter electrode of a projection -- penetration -- since it is embedded at the conductor -- a location gap -- it can control -- consequently, the electrode of an electronic device and wiring -- connection of a conductor can consider as the wiring substrate with an electronic device excellent in good connection dependability.

[0045] moreover -- according to the wiring substrate with an electronic device of this invention -- the above-mentioned configuration -- setting -- penetration -- the point of the electrode of the letter of a projection of an electronic device since a conductor shall be consisted of a conductive paste -- penetration -- the time of embedding at a conductor -- a conductive paste -- the electrode whole -- a wrap -- things are made, consequently both connection area can become large, connection can be strengthened, and it can carry out as a wiring substrate with an electronic device with high connection dependability.

[0046] Furthermore, while according to the manufacture approach of the wiring substrate with an electronic device of this invention forming a through tube in an insulating layer and filling up this through tube with a conductive paste wiring electrically connected with this conductive paste, while carrying the process which forms a conductor, and the electronic device which has the electrode of the letter of a projection on an insulating layer From providing the process which embeds the point of an electrode at a conductive paste, and the process which stiffens a conductive paste after an appropriate time It can fix [consequently] firmly to a conductor. the electrode of the letter of a projection of an electronic device -- penetration -- the time of embedding at a conductor -- penetration -- stiffening a conductive paste, while being able to embed easily, since the conductive paste which forms a conductor is in the condition of not hardening -- the electrode of an electronic device -- penetration -- the case where a spalling test is performed -- also setting -- an electronic device and wiring -- a conductor -- the wiring substrate with an electronic device which is not exfoliated and disconnected in between can be manufactured easily.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing an example of the gestalt of operation of the wiring substrate with an electronic device of this invention.
[Drawing 2] It is the sectional view showing other examples of the gestalt of operation of the wiring substrate with an electronic device of this invention.
[Drawing 3] (a) - (g) is a sectional view for every process for explaining the manufacture approach of the wiring substrate with an electronic device of this invention.
[Description of Notations]
1a ..... Insulating layer
1 11a ..... Insulating substrate
2 and 12 ..... wiring -- a conductor
3a, 13a ..... Through tube
3b and 13b ..... penetration -- a conductor
4 14 ..... Electronic device
4a, 14a ..... Electrode of the letter of a projection
5 15 ..... Wiring substrate with an electronic device

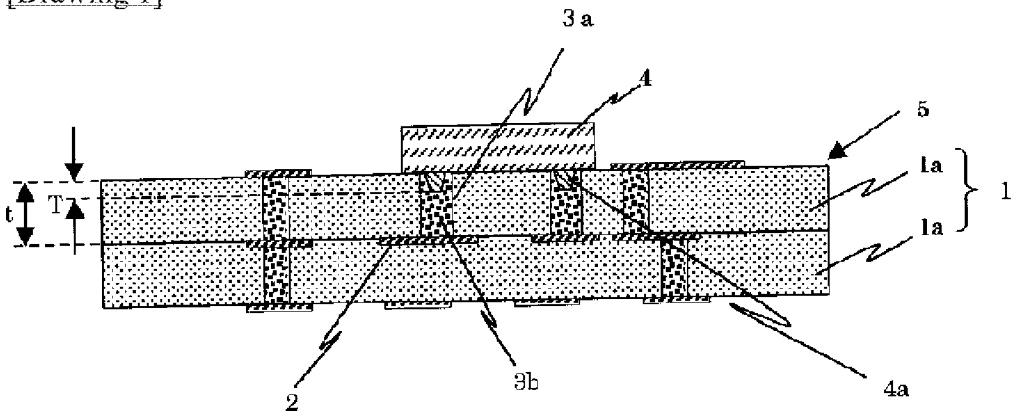
[Translation done.]

* NOTICES *

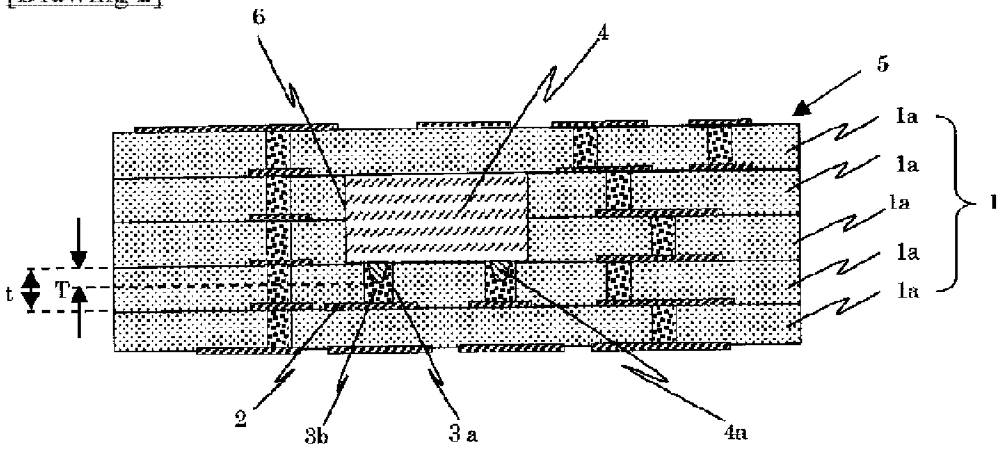
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

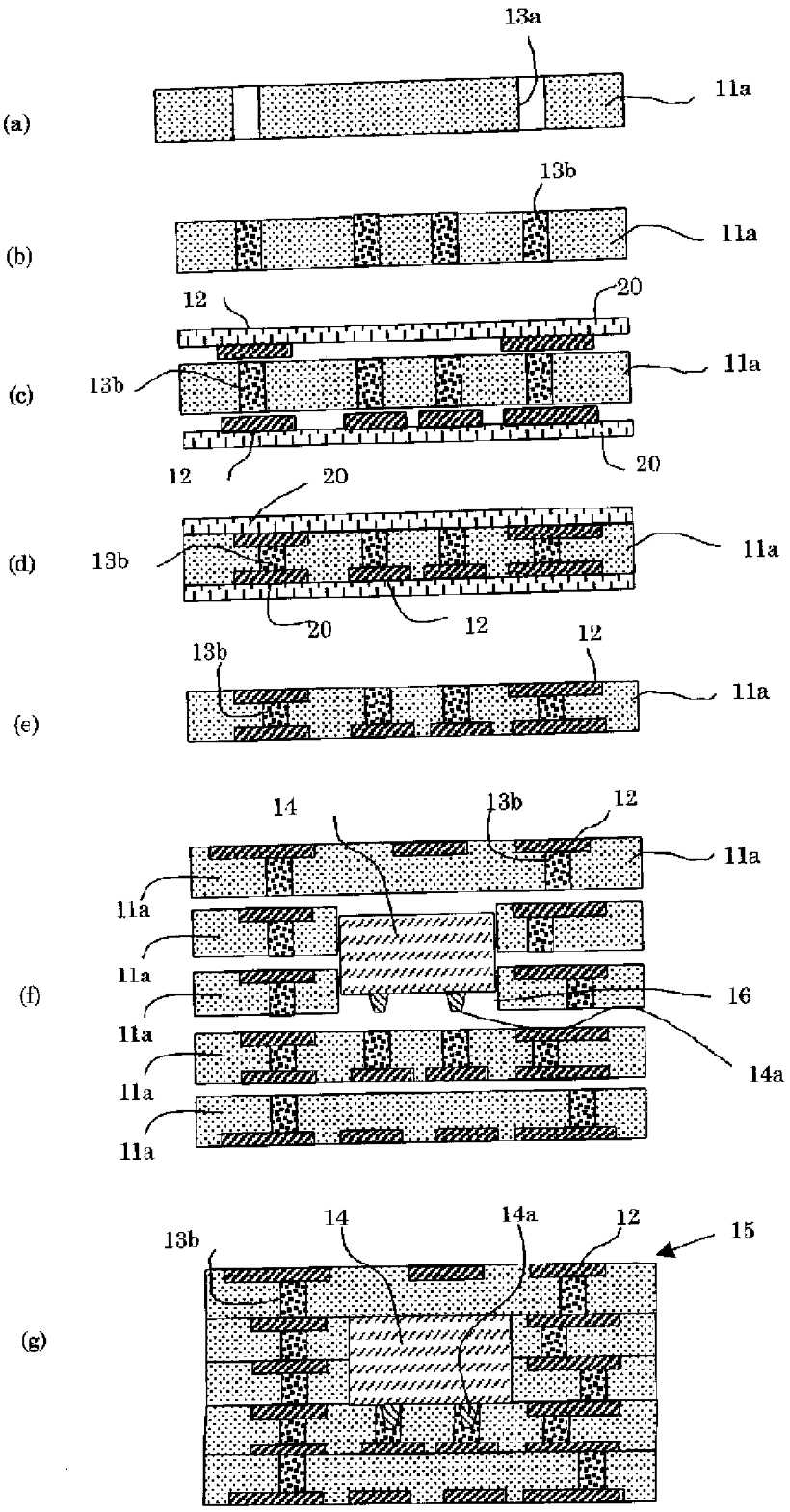
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号
特開2003－46215
（P2003－46215A）
(43)公開日　平成15年２月14日(2003.2.14)

(51)Int.Cl.[7]	識別記号	ＦＩ		テーマコード（参考）
Ｈ０５Ｋ　1/18		Ｈ０５Ｋ　1/18	Ｋ	５Ｅ３１７
Ｈ０１Ｌ　23/12		3/40	Ｋ	５Ｅ３３６
Ｈ０５Ｋ　3/40		Ｈ０１Ｌ　23/12	Ｎ	

審査請求　未請求　請求項の数３　ＯＬ　（全　９　頁）

(21)出願番号　特願2001－228420(P2001－228420)

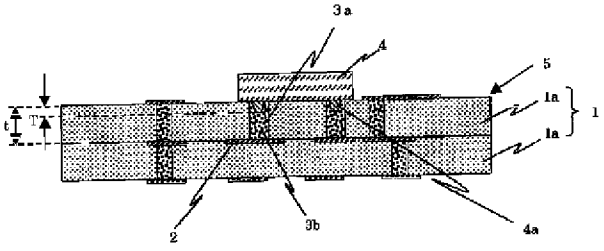
(22)出願日　平成13年７月27日(2001.7.27)

(71)出願人　000006633
京セラ株式会社
京都府京都市伏見区竹田鳥羽殿町６番地
(72)発明者　世利　拓司
鹿児島県国分市山下町１番１号　京セラ株式会社鹿児島国分工場内
(72)発明者　林　桂
鹿児島県国分市山下町１番１号　京セラ株式会社鹿児島国分工場内

最終頁に続く

(54)【発明の名称】　電子素子付配線基板およびその製造方法

(57)【要約】
【課題】電子素子付配線基板において小型化・高密度化した場合、耐熱衝撃性・接続信頼性を満足できない。
【解決手段】　絶縁層１ａと、絶縁層１ａに配設された配線導体２と、配線導体２に電気的に接続されるとともに電子素子４の電極４ａに電気的に接続される貫通導体３ｂと、絶縁層１ａ上に搭載され、その電極４ａが貫通導体３ｂと電気的に接続された電子素子４とを具備してなる電子素子付配線基板５であって、電子素子４の電極４ａは突起状であるとともに、その先端部が貫通導体３ｂ埋め込まれていることを特徴とする。電子素子４の電極４ａが貫通導体３ｂにアンカー効果により強固に接続されるため、熱衝撃試験・半田リフローを行なった場合でも、電子素子４と配線導体２間で剥離して断線してしまうことはなく、耐熱衝撃性・接続信頼性に優れた電子素子付配線基板５となる。



【特許請求の範囲】
【請求項１】　絶縁層と、該絶縁層に配設された配線導体と、該配線導体に電気的に接続されるとともに電子素子の電極に電気的に接続される貫通導体と、前記絶縁層上に搭載され、その電極が前記貫通導体と電気的に接続された電子素子とを具備してなる電子素子付配線基板であって、前記電子素子の電極は突起状であるとともに、その先端部が前記貫通導体に埋め込まれていることを特徴とする電子素子付配線基板。
【請求項２】　前記貫通導体が導電性ペーストから成ることを特徴とする請求項１記載の電子素子付配線基板。
【請求項３】　絶縁層に貫通孔を形成し、該貫通孔に導電性ペーストを充填するとともに、該導電性ペーストと電気的に接続される配線導体を形成する工程と、前記絶縁層上に突起状の電極を有する電子素子を搭載するとともに、前記電極の先端部を前記導電性ペーストに埋め込む工程と、しかる後、前記導電性ペーストを硬化させる工程とを具備することを特徴とする電子素子付配線基板の製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、各種ＡＶ機器や家電機器・通信機器・コンピュータやその周辺機器等の電子機器に使用される配線基板に関し、特に配線基板の一部に電子素子を搭載して成る電子素子付配線基板に関する。
【０００２】
【従来の技術】従来、電子素子付配線基板はアルミナ等のセラミックス材料から成る絶縁層あるいはガラスエポキシ樹脂等の有機樹脂材料から成る絶縁層の内部および表面に複数の配線導体を形成し、この表面に半導体素子やコンデンサ・抵抗素子等の電子素子を搭載取着するとともにこれらの電極を各配線導体に接続することによって形成されている。
【０００３】しかしながら、近年、電子機器は、移動体通信機器に代表されるように小型・薄型・軽量化が要求されてきており、このような電子機器に搭載される電子素子付配線基板も小型・高密度化が要求されるようになってきている。このため、電子素子付配線基板に搭載する電子素子も小型のものが採用され、できるだけ実装面積を小さくすることが必要になってきている。
【０００４】また、最近では電子素子付配線基板の表面に実装される電子素子の数を減らして電子素子付配線基板を小型化する目的で、配線基板内部に電子素子を実装することも提案されている。
【０００５】
【発明が解決しようとする課題】しかしながら、近年、ますます小型・高密度化が要求されるようになり、電子素子付配線基板の配線導体が微細化するとともに、電子素子付配線基板表面あるいは内部に実装される電子素子も小型化し、電子素子と配線導体との接続部の面積が小さくなり、高温と低温のサイクル試験である熱衝撃試験を行なった場合、電子素子の電極と絶縁層との熱膨張係数の差により両者に大きな応力が発生して、電子素子と配線導体間で剥離して断線してしまうという問題点を有していた。
【０００６】また、電子素子を配線基板上に搭載する際の、高温リフロー工程において、絶縁層の熱膨張と電子素子の熱膨張の差によって、電子素子の位置ずれが発生してしまい、その結果、電子素子の電極と配線導体の接続が正常にできないという問題点も有していた。
【０００７】本発明はかかる従来技術の問題点に鑑み案出されたものであり、その目的は、耐熱衝撃性・接続信頼性に優れた小型で軽量な電子素子付配線基板を提供することにある。
【０００８】
【課題を解決するための手段】本発明の電子素子付配線基板は、絶縁層と、この絶縁層に配設された配線導体と、この配線導体に電気的に接続されるとともに電子素子の電極に電気的に接続される貫通導体と、絶縁層上に搭載され、その電極が貫通導体と電気的に接続された電子素子とを具備してなる電子素子付配線基板であって、電子素子の電極は突起状であるとともに、その先端部が貫通導体に埋め込まれていることを特徴とするものである。
【０００９】また、本発明の電子素子付配線基板は、貫通導体が導電性ペーストから成ることを特徴とするものである。
【００１０】さらに、本発明の電子素子付配線基板の製造方法は、絶縁層に貫通孔を形成し、この貫通孔に導電性ペーストを充填するとともに、この導電性ペーストと電気的に接続される配線導体を形成する工程と、絶縁層上に突起状の電極を有する電子素子を搭載するとともに、電極の先端部を導電性ペーストに埋め込む工程と、しかる後、導電性ペーストを硬化させる工程とを具備することを特徴とするものである。
【００１１】本発明の電子素子付配線基板によれば、電子素子の電極を突起状とするとともに、その先端部が貫通導体に埋め込まれていることから、電子素子の電極が貫通導体にアンカー効果により強固に接続され、高温と低温のサイクル試験である熱衝撃試験を行なった場合においても、電子素子と配線導体間で剥離して断線してしまうことがない。また、電子素子を実装する際の高温リフローの際に、電子素子と絶縁層の熱膨張に差が生じたとしても、突起状電極が貫通導体に埋めこまれているため位置ずれを抑制することができ、その結果、電子素子の電極と配線導体の接続が良好な接続信頼性に優れた電子素子付配線基板とすることができる。
【００１２】また、本発明の電子素子付配線基板によれば、上記構成において、貫通導体を導電性ペーストから

成るものとしたことから、電子素子の突起状の電極の先端部を貫通導体に埋め込んだ際に導電性ペーストが電極全体を覆うことができ、その結果、両者の接続面積が大きくなり接続を強固とすることができ、接続信頼性の高い電子素子付配線基板とすることができる。

【００１３】さらに、本発明の電子素子付配線基板の製造方法によれば、絶縁層に貫通孔を形成し、この貫通孔に導電性ペーストを充填するとともに、この導電性ペーストと電気的に接続される配線導体を形成する工程と、絶縁層上に突起状の電極を有する電子素子を搭載するとともに、電極の先端部を導電性ペーストに埋め込む工程と、しかる後、導電性ペーストを硬化させる工程とを具備することから、電子素子の突起状の電極を貫通導体に埋め込む際に、貫通導体が未硬化状態であるために容易に埋め込むことができるとともに導電性ペーストを硬化させることによって電子素子の電極を貫通導体に強固に固着することができ、その結果、熱衝撃試験を行なった場合においても、電子素子と配線導体間で剥離して断線してしまうことのない電子素子付配線基板を容易に製作することができる。

【００１４】

【発明の実施の形態】次に本発明の電子素子付配線基板を添付の図面に基づいて詳細に説明する。

【００１５】図１は、本発明の電子素子付配線基板の実施形態の一例を示す断面図であり、また、図２は、本発明の電子素子付配線基板において電子素子を配線基板内部に搭載した場合の実施形態の一例を示す断面図である。これらの図において、１ａは絶縁層、１は複数の絶縁層１ａから成る絶縁基板、２は配線導体、３ａは貫通孔、３ｂは貫通導体、４はコンデンサ等の電子素子で、主にこれらで本発明の電子素子付配線基板５が構成されている。なお、図１には2層の絶縁層１ａを積層して、図２には5層の絶縁層１ａを積層して電子素子付配線基板５を製作した例を示している。また、図２の実施例では、絶縁層１ａの一部（本例では二層）には電子素子４を収納する貫通穴６が設けられており、この貫通穴６に電子素子４が埋設されている。さらに、絶縁層１ａ表面には配線導体２が配設され、貫通導体３ｂを介して電子素子４の電極４ａと電気的に接続している。また、本発明の電子素子付配線基板５では電子素子４の電極４ａは突起状であり、貫通導体３ｂに埋め込まれている。

【００１６】絶縁層１ａは、配線導体２や電子素子４の支持体としての機能を有し、アルミナやガラスセラミックス等のセラミック材料、あるいはエポキシ樹脂やビスマレイミドトリアジン樹脂・熱硬化性ポリフェニレンエーテル樹脂・液晶ポリマー樹脂等の有機樹脂材料から成り、特に、軽量化・微細化・高周波特性・加工性の観点からは熱硬化性ポリフェニレンエーテル樹脂や液晶ポリマー樹脂等の有機樹脂材料から成ることが好ましい。

【００１７】なお、絶縁層１ａが有機樹脂材料から成る場合は、機械的強度を向上させるためのシラン系やチタネート系等のカップリング剤、熱安定性を改善するための酸化防止剤や耐光性を改善するための紫外線吸収剤等の光安定剤、難燃性を改善するためのハロゲン系もしくはリン酸系の難燃性剤、アンチモン系化合物やホウ酸亜鉛・メタホウ酸バリウム・酸化ジルコニウム等の難燃助剤、潤滑性を改善するための高級脂肪酸や高級脂肪酸エステル・高級脂肪酸金属塩・フルオロカーボン系界面活性剤等の滑剤、熱膨張係数を調整するためおよび／または機械的強度を向上させるための酸化アルミニウム・酸化珪素・酸化チタン・酸化バリウム・酸化ストロンチウム・酸化ジルコニウム・酸化カルシウム・ゼオライト・窒化珪素・窒化アルミニウム・炭化珪素・チタン酸カリウム・チタン酸バリウム・チタン酸ストロンチウム・チタン酸カルシウム・ホウ酸アルミニウム・スズ酸バリウム・ジルコン酸バリウム・ジルコン酸ストロンチウム等の充填材、あるいは、繊維状ガラスを布状に織り込んだガラスクロス等を含有させてもよい。

【００１８】このような絶縁層１ａは、例えば粒径が0.1～15μｍ程度の酸化アルミニウム・窒化珪素・窒化アルミニウム・炭化珪素・酸化チタン・酸化バリウム・酸化ストロンチウム・酸化ジルコニウム・酸化カルシウム等の無機絶縁粉末に、エポキシ樹脂・フェノール樹脂・ポリイミド樹脂・ビスマレイミド樹脂・熱硬化性ポリフェニレンエーテル樹脂等の熱硬化性樹脂または液晶ポリエステル・ポリフェニレンエーテル樹脂等の熱可塑性樹脂と溶剤・可塑剤・分散剤等を添加して得たペーストを従来周知のドクタブレード法等のシート成型法を採用してシート状となすことによって、あるいは、上記のペースト中に繊維状ガラスを布状に織り込んだガラスクロスガラスを浸漬し垂直に引き上げ乾燥することによって絶縁層１ａと成る前駆体シートを形成し、しかる後、所望の大きさに切断することによって得られる。

【００１９】なお、搭載される電子素子４が図２に断面図で示すように絶縁基板１の内部に形成される場合は、一部の絶縁層１ａに電子素子４を収容するための貫通穴６が穿設されている。このような貫通穴６は、従来周知のレーザ加工法による穿設加工やパンチング法による打ち抜き加工を施すことにより絶縁層１ａに、電子素子４の大きさ・形状に合わせて形成される。

【００２０】また、絶縁層１ａには、上下面の少なくとも１つの面に配線導体２が被着形成されている。配線導体２は、その厚みが２～30μｍ程度で銅・金等の良導電性の金属箔や銅や銀・タングステン・モリブデン等の導電性ペーストから成り、電子素子付配線基板５に搭載される電子素子４を外部電気回路（図示せず）に電気的に接続する機能を有する。

【００２１】このような配線導体２は、絶縁層１ａとなる前駆体シートに、公知のフォトレジストを用いたサブトラクティブ法によりパターン形成した、例えば銅から

成る金属箔を転写法等により被着形成することによって、あるいは銅や銀・タングステン・モリブデン等の金属粉末を熱硬化性樹脂または熱可塑性樹脂および溶剤・可塑剤・分散剤等を添加して得た導電性ペーストを従来周知のスクリーン印刷法を用いて印刷することによって形成される。

【００２２】さらに、絶縁層１ａには、直径が20～150μｍ程度の貫通導体３ｂが形成されている。貫通導体３ｂは、絶縁層１ａを挟んで上下に位置する配線導体２同士および配線導体２と電子素子４の電極４ａとを電気的に接続する機能を有する。このような貫通導体３ａは、絶縁層１ａにレーザにより穿設加工を施すことにより貫通孔３ａを形成した後、この貫通孔３ａに銅・銀・金・半田等から成る導電性ペーストを従来周知のスクリーン印刷法により埋め込むことによって形成される。

【００２３】そしてこの貫通導体３ｂの一部には、搭載される電子素子４の各電極４ａが電気的に接続されおり、本発明の電子素子付配線基板５においては、電子素子４の電極４ａが突起状であるとともに、その先端部が貫通導体３ｂに埋め込まれている。また、このことが重要である。

【００２４】本発明の電子素子付配線基板５によれば、電子素子４の電極４ａを突起状とするとともに、その先端部が貫通導体３ｂに埋め込まれていることから、電子素子４の電極４ａが貫通導体３ｂにアンカー効果により強固に接続され、高温と低温のサイクル試験である熱衝撃試験を行なった場合でも、電子素子４と配線導体２間で剥離して断線してしまうことがない。また、電子素子４を実装する際の高温リフローの際に、電子素子４と絶縁層１ａの熱膨張に差が生じたとしても、突起状の電極４ａが貫通導体３ｂにアンカー効果により強固に接続されるため電子素子４の位置ずれを抑制することができ、その結果、電子素子４の電極４ａと配線導体２の接続が良好な接続信頼性に優れた電子素子付配線基板５とすることができる。

【００２５】このような電子素子４の突起状の電極４ａは、電子素子４の表面に銅や銀・タングステン・モリブデン等の導電性ペーストを従来周知のスクリーン印刷法を採用して繰り返し印刷することにより形成される。

【００２６】なお、電子素子４の電極４ａの突起形状は、絶縁層１ａに平行な方向の断面が円形や楕円形あるいは多角形でもよいが、接続部の応力を緩和するという観点からは、円形や楕円形であることが好ましい。また、絶縁層１ａに平行な方向の電極４ａの断面積は、突起状の電極４ａを貫通導体３ｂに埋め込む際に空気のかみ込みを防止するという観点からは、電子素子４との接続部よりも先端部の方が小さくなっていることが好ましい。さらに、電極４ａの高さＴは、絶縁層１ａの厚さをｔとした時に0.1ｔ～0.5ｔの範囲が好ましく、電極４ａの高さＴが0.1t未満であると十分なアンカー効果が得られず、その結果、熱衝撃試験で接続部が断線してしまう傾向があり、0.5tを超えると電子素子付配線基板５を最終的に加圧・加熱して多層化する際、導電性ペーストが貫通孔３ａから大きくはみだしてしまい、絶縁層１ａ同士の密着不良を発生させてしまう危険性がある。従って、電極４ａの高さＴは、絶縁層１の厚さｔに対して0.1t～0.5tであることが好ましい。

【００２７】また、突起状の電極４ａの絶縁層１ａに平行な方向の断面の径は、貫通穴６の直径よりやや小さく、求められる位置精度により決めればよい。さらに、電子素子４と貫通導体３ｂの接続は、電子素子４の突起状の電極４ａを未硬化の貫通導体３ｂ中に差し込み、しかる後、加熱して貫通導体３ｂを硬化することによって行なわれる

このような電子素子付配線基板５は、次の方法により製作される。まず、絶縁層１ａと成る前駆体シートの所望の位置にレーザ穿設加工等により貫通孔３ａを形成し、この貫通孔３ａに銅等から成る導電性ペーストを、例えばスクリーン印刷法を用いて充填し貫通導体３ｂを形成した後、パターン形成した、例えば銅の金属箔を、温度が100～200℃、圧力が0.5～10ＭＰａの条件で10分～１時間ホットプレスして絶縁層１ａに転写して配線導体２と貫通導体３ｂとを電気的に接続し、配線導体２および貫通導体３ｂが形成された第１の絶縁層１ａを得る。なお、この時、貫通導体３ｂは完全に硬化していない未硬化状態としておくことが好ましい。次に、上記の絶縁層１ａとは別に、絶縁層１ａと成る前駆体シートの所望の位置にレーザ穿設加工等により貫通孔３ａを形成し、この貫通孔３ａに銅等から成る導電性ペーストを、例えばスクリーン印刷法を用いて充填して貫通導体３ｂを形成した後、電子素子４をその突起状の電極４ａが貫通導体３ｂに埋入されるように搭載し、電子素子４を有する第２の絶縁層１ａを得る。そして、第１および第２の絶縁層１ａを、第１の絶縁層１ａの配線導体２と第２のの絶縁層１ａの貫通導体３ｂとが重なるように積層し、しかる後、温度が150～300℃、圧力が0.5～10ＭＰａの条件で30分～24時間ホットプレスして前駆体シートおよび導電性ペーストを完全硬化させることによって製作される。

【００２８】なお、電子素子４を配線基板内部に形成する場合は、第２の絶縁層１ａの上面に、電子素子４と対応する領域に電子素子４よりも若干大きめの貫通穴６を形成した第１の絶縁層１ａを積層し、しかる後、上記と同様の条件でホットプレスすればよい。また、電子素子４を搭載した第２の絶縁層１に配線導体２を形成しておいてもよい。この場合、貫通導体３ｂを完全に硬化していない未硬化状態にしておくことにより、電子素子４の突起状の電極４ａを貫通導体３ｂに容易に埋入することができる。

【００２９】かくして本発明の電子素子付配線基板５に

よれば、電子素子４の電極４ａを突起状とするとともに、その先端部が貫通導体３ｂに埋め込まれていることから、電子素子４の電極４ａが貫通導体３ｂにアンカー効果により強固に接続され、高温と低温のサイクル試験である熱衝撃試験を行なった場合においても、電子素子４と配線導体２間で剥離して断線してしまうことがない。また、電子素子４を実装する際の高温リフローの際に、電子素子４と絶縁層１ａの熱膨張に差が生じたとしても、突起状電極４ａが貫通導体３ｂに埋めこまれていることから位置ずれを抑制することができ、その結果、電子素子４の電極４ａと配線導体２の接続が良好な接続信頼性に優れた電子素子付配線基板５とすることができる。

【００３０】次に、本発明の電子素子付配線基板の製造方法を図３に基づいて詳細に説明する。図３は、図２の電子素子付配線基板を製作するための工程毎の断面図である。

【００３１】まず、図３（ａ）に断面図で示すように、絶縁層11aと成る未硬化の前駆体シートを準備し、この前駆体シートにレーザ加工により所望の個所に直径が20～150μｍ程度の貫通孔13ａを穿設する。

【００３２】このような絶縁層11aと成る未硬化の前駆体シートは、アルミナやガラスセラミックス等のセラミック材料、あるいはエポキシ樹脂やビスマレイミドトリアジン樹脂・熱硬化性ポリフェニレンエーテル樹脂・液晶ポリマー樹脂等の有機樹脂材料から成り、絶縁層11aが有機樹脂材料から成る場合は、機械的強度を向上させるためのシラン系やチタネート系等のカップリング剤、熱安定性を改善するための酸化防止剤や耐光性を改善するための紫外線吸収剤等の光安定剤、難燃性を改善するためのハロゲン系もしくはリン酸系の難燃性剤、アンチモン系化合物やホウ酸亜鉛・メタホウ酸バリウム・酸化ジルコニウム等の難燃助剤、潤滑性を改善するための高級脂肪酸や高級脂肪酸エステル・高級脂肪酸金属塩・フルオロカーボン系界面活性剤等の滑剤、熱膨張係数を調整するためおよび／または機械的強度を向上させるための酸化アルミニウム・酸化珪素・酸化チタン・酸化バリウム・酸化ストロンチウム・酸化ジルコニウム・酸化カルシウム・ゼオライト・窒化珪素・窒化アルミニウム・炭化珪素・チタン酸カリウム・チタン酸バリウム・チタン酸ストロンチウム・チタン酸カルシウム・ホウ酸アルミニウム・スズ酸バリウム・ジルコン酸バリウム・ジルコン酸ストロンチウム等の充填材、あるいは、繊維状ガラスを布状に織り込んだガラスクロス等を含有させてもよい。

【００３３】このような前駆体シートは、例えば、絶縁材料として熱硬化性樹脂と無機絶縁粉末との複合材料を用いる場合、以下の方法によって製作される。まず、前述した無機絶縁粉末に熱硬化性樹脂を無機絶縁粉末量が20～80体積％となるように溶媒とともに加えてた混合物を得、この混合物を混練機（ニーダ）や３本ロール等の手段によって混合してペーストを製作する。そして、このペーストを圧延法や押し出し法・射出法・ドクターブレード法などのシート成形法を採用してシート状に成形した後、熱硬化性樹脂が完全硬化しない温度に加熱して乾燥することにより絶縁層11aとなる前駆体シートが製作する。なお、ペーストは、好適には、熱硬化性樹脂と無機絶縁粉末の複合材料に、トルエン、酢酸ブチル、メチルエチルケトン、メタノール、メチルセロソルブアセテート、イソプロピルアルコール、メチルイソブチルケトン、ジメチルホルムアミド等の溶媒を添加してなる所定の粘度を有する流動体であり、その粘度は、シート成形法にもよるが100～3000ポイズが好ましい。

【００３４】次に、図３（ｂ）に断面図で示すように、貫通孔13ａ内に銅・銀・金・半田等から成る導電性ペーストを従来周知のスクリーン印刷法等を採用して充填し、貫通導体13ｂを形成する。

【００３５】次に、図３（ｃ）に断面図で示すように、前駆体シートの表面と裏面とに被着する配線導体12を準備する。そして、図３（ｄ）に断面図で示すように、配線導体12を前駆体シートの表面および裏面に、必要な配線導体12と貫通導体13aとが電気的に接続するように重ね合わせて転写する。

【００３６】なお、本実施例では、配線導体12の形成を転写法によって行っており、このような配線導体12は、次に述べる方法により形成される。まず、離型シート等の支持体20の表面にメッキ法などによって製作され、銅・金・銀・アルミニウム等から選ばれる１種または２種以上の合金からなる厚さ１～35μｍの電解金属箔を接着し、その表面に所望の配線パターンの鏡像パターンとなるようにレジスト層を形成した後、エッチング、レジスト除去によって所定の配線パターンの鏡像の配線導体12が形成される。次に、配線導体12の前駆体シートの表面および裏面への被着は、配線導体12が形成された支持体20を前駆体シートの表面および裏面へ重ね合わせ、しかる後、圧力が0.5～10ＭＰａ、温度が60～150℃の条件で加圧加熱した後、支持体20を剥がすことにより、図３（ｅ）に断面図に示すように配線導体12が前駆体シートに被着される。なお、この時、貫通導体13ｂは、完全に硬化していない未硬化状態としておくことが重要である。

【００３７】また、支持体20としては、ポリエチレンテレフタレート、ポリエチレンナフタレート、ポリイミド、ポリフェニレンサルファイド、塩化ビニル、ポリプロピレン等公知のものが使用できる。支持体の厚みは10～100μｍが適当であり、望ましくは25～50μｍが良い。支持体の厚みが10μｍ未満であると支持体の変形や折れ曲がりにより形成した配線導体12が断線し易くなり、厚みが100μｍを超えると支持体の柔軟性がなくなって、前駆体シートからの支持体20の剥離が困難となる

傾向がある。また、支持体20表面に電解金属箔を形成するために、アクリル系やゴム系・シリコン系・エポキシ系等公知の接着剤を使用してもよい。

【００３８】そして、図３（ｆ）に断面図で示すように、上記(a)～（ｆ）の工程を経て製作した複数の前駆体シートと、突起状の電極14aを有する電子素子14とを準備し、次に、電極14aの先端部を導電性ペーストから成る貫通導体13bに埋めこむとともに前駆体シートを積層し、温度が150～300℃、圧力が0.5～10ＭＰａの条件で30分～24時間ホットプレスして前駆体シートおよび導電性ペーストを完全硬化させることによって、図３（ｇ）に断面図で示す本発明の電子素子付配線基板15が完成する。

【００３９】なお、図３では、電子素子14を配線基板の内部に形成した例を示しているが、電子素子14を収容する貫通穴16は、前駆体シートを積層する前に、前駆体シートの電子素子14が収容される個所にレーザ法やパンチング法により穿設しておけばよい。

【００４０】以上説明したように、本発明の電子素子付配線基板15の製造方法によれば、電子素子14の突起状の電極14aを貫通導体13bを形成する導電性ペーストに埋め込む際に、導電性ペーストが未硬化状態であるために容易に埋め込むことができるとともに導電性ペーストを硬化させることによって電子素子14の電極14aを導電性ペーストから成る貫通導体13bに強固に固着することができ、その結果、熱衝撃試験を行なった場合においても、電子素子14と配線導体12間で剥離して断線してしまうことのない電子素子付配線基板15を容易に製作できる。

【００４１】なお、電子素子14の突起状の電極14aは、電子素子14の表面に銅や銀・タングステン・モリブデン等の導電性ペーストを従来周知のスクリーン印刷法を採用して繰り返し印刷することにより形成される。さらに、電子素子14の電極14aの突起形状は、絶縁層11aに平行な方向の断面が円形や楕円形あるいは多角形でもよいが、接続部の応力を緩和するという観点からは、円形や楕円形であることが好ましい。また、絶縁層11aに平行な方向の電極14aの断面積は、突起状の電極14aを貫通導体13bに埋め込む際に空気のかみ込みを防止するという観点からは、電子素子14との接続部よりも先端部の方が小さくなっていることが好ましい。さらに、電極14aの高さＴは、絶縁層11aの厚さをｔとした時に0.1ｔ～0.5ｔの範囲が好ましく、電極14aの高さＴが0.1t未満であると十分なアンカー効果が得られず、その結果、熱衝撃試験で接続部が断線してしまう傾向があり、0.5tを超えると電子素子付配線基板15を最終的に加圧・加熱して多層化する際、導電性ペーストが貫通孔13aから大きくはみだしてしまい、絶縁層11a同士の密着不良を発生させてしまう危険性がある。従って、電極14aの高さＴは、絶縁層11aの厚さｔに対して0.1t～0.5tであることが好ましい。また、突起状の電極14aの絶縁層11aに平行な方向の断面の径は、貫通穴16の直径よりやや小さく、求められる位置精度により決めればよい。

【００４２】かくして本発明の電子素子付配線基板の製造方法によれば、電子素子の電極と配線導体の接続が良好な接続信頼性に優れた電子素子付配線基板を提供することができる。

【００４３】なお、上述の例では電子素子付配線基板に搭載される電子素子が１個の場合の例を示したが、複数の電子素子を配線基板の表面や内部に形成することは何ら問題ない。

【００４４】

【発明の効果】本発明の電子素子付配線基板によれば、電子素子の電極を突起状とするとともに、その先端部が貫通導体に埋め込まれていることから、電子素子の電極が貫通導体にアンカー効果により強固に接続され、高温と低温のサイクル試験である熱衝撃試験を行なった場合においても、電子素子と配線導体間で剥離して断線してしまうことがない。また、電子素子を実装する際の高温リフローの際に、電子素子と絶縁層の熱膨張に差が生じたとしても、突起状電極が貫通導体に埋めこまれているため位置ずれを抑制することができ、その結果、電子素子の電極と配線導体の接続が良好な接続信頼性に優れた電子素子付配線基板とすることができる。

【００４５】また、本発明の電子素子付配線基板によれば、上記構成において、貫通導体を導電性ペーストから成るものとしたことから、電子素子の突起状の電極の先端部を貫通導体に埋め込んだ際に導電性ペーストが電極全体を覆うことができ、その結果、両者の接続面積が大きくなり接続を強固とすることができ、接続信頼性の高い電子素子付配線基板とすることができる。

【００４６】さらに、本発明の電子素子付配線基板の製造方法によれば、絶縁層に貫通孔を形成し、この貫通孔に導電性ペーストを充填するとともに、この導電性ペーストと電気的に接続される配線導体を形成する工程と、絶縁層上に突起状の電極を有する電子素子を搭載するとともに、電極の先端部を導電性ペーストに埋め込む工程と、しかる後、導電性ペーストを硬化させる工程とを具備することから、電子素子の突起状の電極を貫通導体に埋め込む際に、貫通導体を形成する導電性ペーストが未硬化状態であるために容易に埋め込むことができるとともに導電性ペーストを硬化させることによって電子素子の電極を貫通導体に強固に固着することができ、その結果、熱衝撃試験を行なった場合においても、電子素子と配線導体間で剥離して断線してしまうことのない電子素子付配線基板を容易に製作することができる。

【図面の簡単な説明】

【図１】本発明の電子素子付配線基板の実施の形態の一例を示す断面図である。

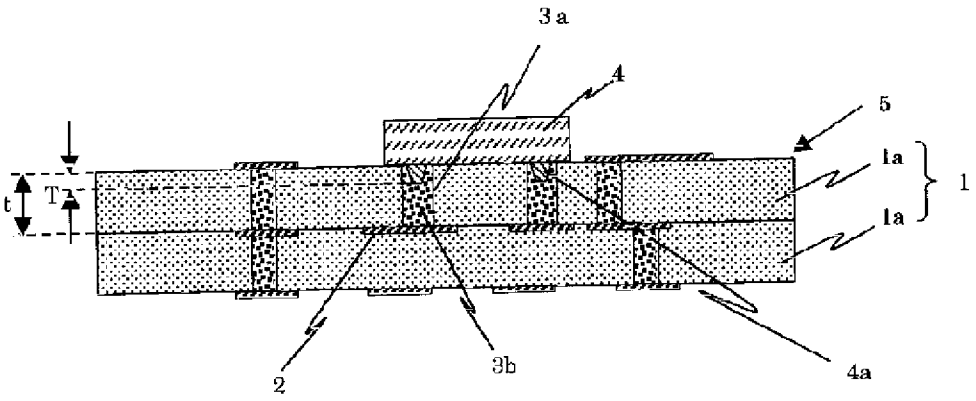
【図２】本発明の電子素子付配線基板の実施の形態の他の例を示す断面図である。

【図３】（ａ）～（ｇ）は、本発明の電子素子付配線基板の製造方法を説明するための工程毎の断面図である。

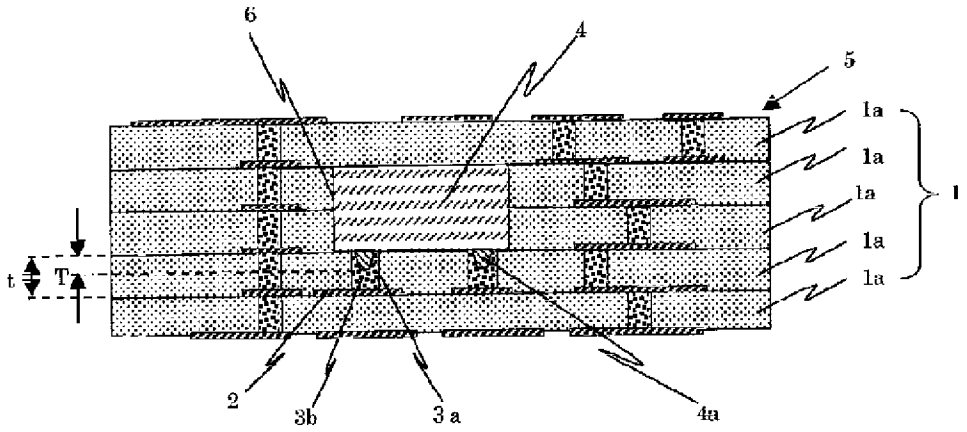
【符号の説明】

１ａ・・・・・・・・・・・・絶縁層
１、11a ・・・・・・・・・・絶縁基板
２、12・・・・・・・・・・・配線導体
３ａ、13a・・・・・・・・・貫通孔
３ｂ、13b・・・・・・・・・貫通導体
４、14・・・・・・・・・・・電子素子
４ａ、14a・・・・・・・・・突起状の電極
５、15・・・・・・・・・・・電子素子付配線基板

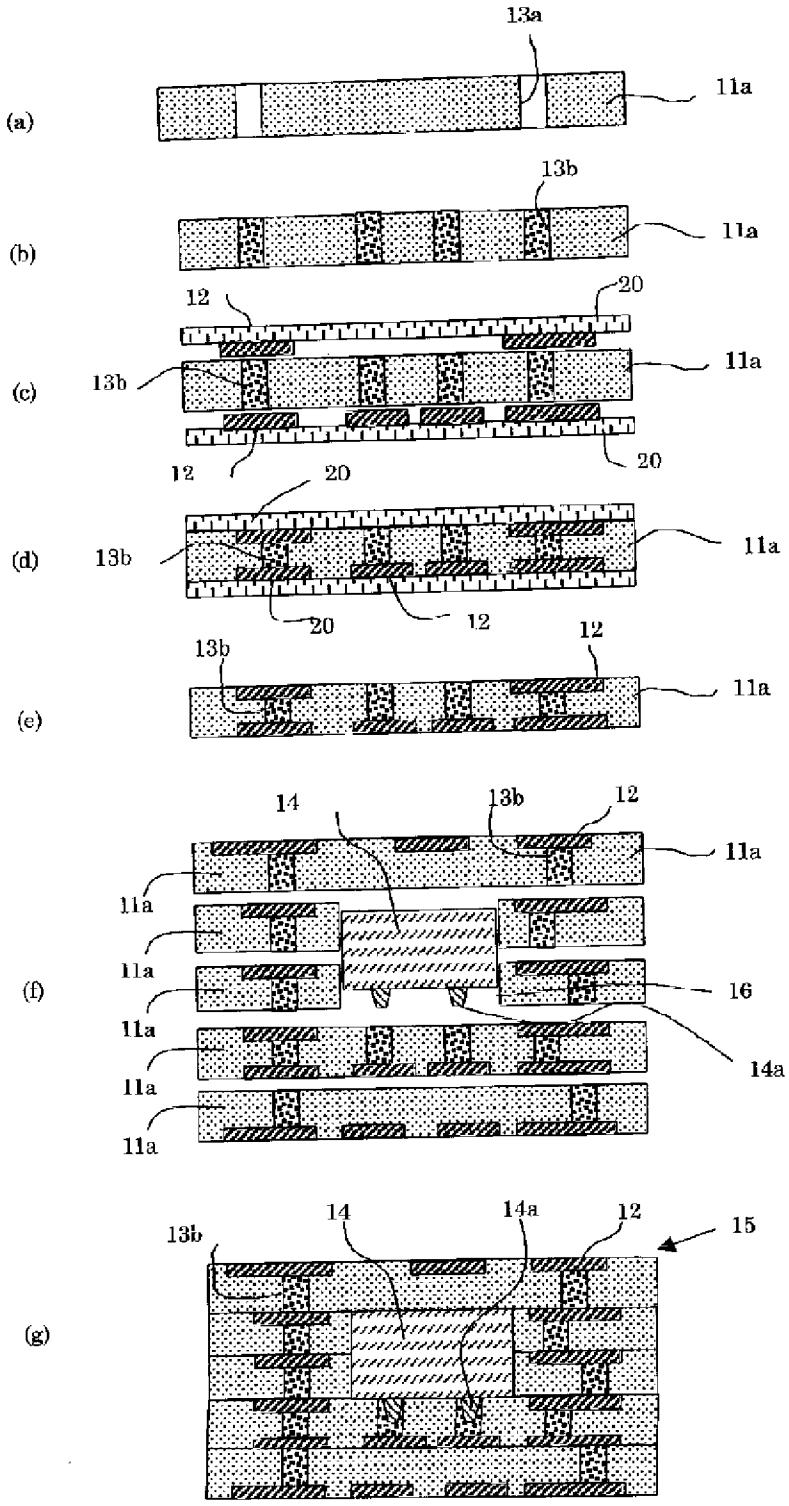
【図１】



【図２】



【図３】


(a)
13a
11a
(b)
13b
11a
(c)
12
20
13b
11a
12
20
(d)
20
13b
11a
20
12
(e)
12
13b
11a
(f)
14
13b
12
11a
11a
11a
11a
11a
11a
16
14a
(g)
13b
14
14a
12
15

フロントページの続き

Ｆターム(参考)　5E317 AA24 BB01 BB02 BB04 BB12
BB13 BB14 BB16 BB17 CC22
CD34
5E336 AA05 BB01 BB03 BB15 BB18
BB19 BC02 CC03 CC32 GG11
GG16